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Research on the Purification and Recycling Process of Cutting Oil for Marine Crankshaft Machining

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Abstract

In order to solve the problem that the cooling lubrication performance decreases due to the deterioration of oil products during the crankshaft processing of marine diesel engines, the clean regeneration process of cutting oil with high efficiency and no pollution is studied. Through on-the-spot investigation and sampling, the lubrication performance of cutting oil samples is studied. It is concluded that the increase of moisture and viscosity and the inclusion of impurities such as particulate matter make the lubrication performance of lubricating oil decrease. In this paper, the self-developed cutting oil purification and regeneration device was used to determine the process route of three-stage filtration, additive treatment and vacuum dehydration. The effects of treatment cycles and treatment temperature on the dehydration rate, and the effects of different additives on the viscosity change were analyzed to optimize the cutting oil purification process. The experimental results show that the optimum processing conditions are as follows: the processing time is three cycles, the constant temperature is adjusted to 60 °C, the filtration accuracy is 75μm-50μm-5μm, and the additive is D80 with 10 % volume fraction. After treatment, the cutting oil pollutant level decreased from NAS12 to NAS8, and the viscosity, moisture, mechanical impurities and other indicators reached the recycling standard. Practice has proved that the cutting oil purification and regeneration process and device developed in this paper provide an effective way to realize the recycling of resources, and promote the green manufacturing and industrial upgrading advocated by China.

Keywords

Marine Crankshaft, Cutting Oil, Lubricating Property, Vacuum Dewatering, Purification and Regeneration, Green Manufacturing, Circulation Reuse.

1. Introduction

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the wear, chip adhesion and thermal deformation between the tool and workpiece during machining, improve the friction state, ensure the machining accuracy and improve the tool life [3]. As the lubricating oil is used on one side of the crankshaft journal and the cutting oil on the other side during finishing machining of the crankshaft journal, it will happen that the lubricating oil is mixed into the cutting oil, and the cutting oil will inevitably deteriorate and the cooling and lubricating properties become poor due to the mixing of impurities such as particulate matter and water in the process of using the cutting oil, which seriously affects the machining accuracy and has a certain impact on the workshop environment and workers' health. Therefore, it is of practical importance to carry out research on cutting oil purification and regeneration to ensure the quality of crankshaft machining, realize resource recycling, reduce production costs, etc [4-5].

According to the degradation degree of waste oil, the regeneration treatment processes for waste oil mainly include repurification process, re-refining process, re-refining process, membrane separation process, electrostatic adsorption process, etc [6-9].

The common methods of repurification process are sedimentation, filtration, flocculation and centrifugation [10-11]. Depending on the water, impurities and colloidal dispersions contained in different waste oils, several steps can be combined at the same time, and these processes are suitable when the main properties do not change significantly. The electrostatic flocculation cell invented by Chongqing Industrial and Commercial University for lube oil re-refining has both electrostatic polymerization and flocculant flocculation [12]. The re-refining process is to remove the substances that have undergone oxidative degradation or foreign contaminants from the waste oil after the water and impurities are not detached or are detached [13]. There are mainly water washing-adsorption refining, alkali washing-adsorption refining, vapor extraction-adsorption refining, dewatering miscellaneous-sulfuric acid-propane refining, distillation dehydration-alcohol extraction flocculation-white clay adsorption and solvent extraction/extraction processes (single solvent refining and compound solvent refining) [14-15]. The common refinement process in the past was the white clay sulfate treatment process [16-17]. This process has been banned in China due to environmental pollution. The purpose of the re-refining process is to remove additives, deterioration products and impurities from waste oil and refine a base oil similar to crude oil. The process is essentially a further addition to the technology of the re-refining process, such as distillation and hydrogenation [18-19].

Membrane separation technology is based on the selective permeability of membranes for the treatment of waste oils. Zhang Chuanbin et al. elaborated the principle of selective permeability of membranes and waste oil treatment, and confirmed the feasibility of inorganic membranes in waste oil treatment based on the principle of reducing oil viscosity to increase the selective permeability of membranes [20]. Fan Yikun et al. treated waste lubricating oil by characteristic ceramic membranes, and their filtration performance and filtration efficiency were improved [21]. Although the membrane separation technology is simple to manufacture the device, the membrane is easily contaminated, and the uneven pressure in the system can cause the membrane filtration to be blocked and thus affect the effect, which needs to be replaced periodically, and the comprehensive efficiency is not easily put into use. The research of high quality composite membrane material is the core task of membrane separation technology at present.

Since the 1970s the development of electrostatic oil purification technology is more ideal, using high pressure electric adsorption technology to remove small particles of oil and water, etc., no secondary pollution, high economic efficiency, but due to the oil deterioration is difficult to determine, and there are certain safety issues, domestic products are not mature, coupled with the high cost, the market has not been promoted. Zhang Desheng et al. of Northeastern Petroleum University developed a waste lubricant purification and regeneration device, and the treated waste lubricant reached the standard of recycling again [22]. Supercritical extraction solvent refining is used to separate materials based on the different binding ability of gases in the supercritical state (SCF) for different compounds. In recent years, supercritical extraction of metalworking oils with CO2 has been reported, which can be recycled by extraction at room temperature.Monica et al. conducted a comparative study of

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supercritical fluid extraction technology and conventional treatment processes and concluded that supercritical extraction technology is argumentatively superior [23-24].

In this paper, an in-depth study was conducted with the purpose of recycling cutting waste oil from a marine crankshaft processing plant. Through testing, the reasons why cutting oil cannot be reused were analyzed, and a reasonable purification and treatment process was found, and the process route of three-stage filtration → additive treatment → vacuum dehydration was finally determined. This process is more green, efficient and pollution-free compared with the traditional process, and has simple equipment, low cost and wide applicability. Liang Hongbao [25] et al. used vacuum dehydration treatment and three-stage parallel circulation filtration treatment, and by testing the main elements and performance indexes contained in the waste gear oil before and after treatment, the main polluting elements in the waste lubricant were effectively reduced and the lubricant performance was improved, and the treated waste lubricant has reached the standard of recycling again. Sun [26] et al. successfully developed a used oil purification and regeneration process including flocculation-sedimentation and three-stage filtration and vacuum dewatering devices to solve the problem of regeneration and utilization of the medium and high viscosity mixed used oil generated by Baosteel.

It has been proved that the cutting oil purification and regeneration process and device developed in this paper are suitable for the purification and regeneration of cutting oil for marine crankshaft processing, which provides an effective way to realize the recycling of resources and has a certain promotion effect on the green manufacturing and industrial upgrading advocated by China.

2. Experiment

2.1 Test Subjects

A crankshaft limited company waste cutting oil, cutting oil crude oil, lubricating oil crude oil.

2.2 Process Handling

We conducted a field survey on the oil situation of crankshaft turning processing site, developed special equipment for marine crankshaft cutting oil purification and regeneration, and designed a set of three-stage filtration combined with additive treatment and vacuum dewatering process treatment plan for waste oil.

2.3 Experimental Method

Before processing waste cutting oil, it is necessary to understand the changes in its relevant physical and chemical performance indicators, in order to analyze the main causes of its deterioration and degradation, and then develop a regeneration treatment process plan. The main performance indicators to be tested are kinematic viscosity, moisture, elemental content, tapping torque value, dispersibility, etc.

2.3.1 Kinematic Viscosity Test

Using SYD-265C kinematic viscosity tester for petroleum products (06081), kinematic viscosity tests were conducted on cutting waste oil, cutting crude oil, lubricating oil and cutting waste oil treated by purification and regeneration process according to GB-T 265-1998 standard.

2.3.2 Moisture Testing

Using the 831KF practical coulometric calorimetric moisture tester (1831001035233), moisture testing was performed on cutting waste oil, cutting crude oil, lubricating oil and cutting waste oil treated by the purification and regeneration process according to the SH/T0255-1992 (2004) standard.

2.3.3 Elemental Testing

The iCAP6300 inductively coupled plasma atomic emission spectrometer (ICP-20110208) was used for elemental testing of cutting waste oil, cutting crude oil, lubricating oil and cutting waste oil treated by the purification and regeneration process according to the standard GB 17476-1998.

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2.3.4 Tapping Torque Test

TTT system G8 tapping torque tester is used to test the tapping torque of cutting waste oil, cutting crude oil, lubricating oil and cutting waste oil after purification and regeneration process. The test environment is room temperature 25 ℃, rotation speed 1200 RPM, torque 300 NCM, cutting depth 12 mm.

2.3.5 Decentralized Stability Testing

The treated oil after adding additive D80 was put into a centrifuge at 3000 r-min-1 with a centrifugation time of 20 minutes and left for one week to observe whether there was stratification.

3. Cutting Oil Purification Process

Cutting oil purification equipment was commissioned from Shanghai Lv Sheng Environmental Protection Co to develop an experimental system, which is designed to remove water and particulate impurities as well as flocculent impurities from waste lubricating oil.

3.1 Pre-Treatment of Waste Cutting Slip Oil

As the materials processed by cutting oil are mostly medium carbon steel, the chips produced by cutting carry a large number of micron-level particles and large particles of impurities visible to human eyes, in order to reduce the difficulty of subsequent purification treatment, pre-filtration is carried out to remove larger particles and flocculants and other impurities. As the viscosity of cutting oil changes after use, according to Stokes' law, the greater the viscosity, the slower the settling speed of particles, in order to increase the capacity of waste cutting oil through the filter and improve the efficiency of oil purification, the waste cutting oil is heated in the first stage. But too high temperature will cause oil deterioration and degradation, so a suitable heating temperature should be selected.

3.2 Cutting Oil Moisture and Impurity Removal

The processing site environment is heavy moisture, a large amount of moisture in the air will be mixed into the oil tank and oil circuit, moisture and metal particles and airborne dust, etc. will gradually mix in the oil to form flocculent, and uniformly exist in the oil, making the processing exist tool bonding and produce oil mist and other unfavorable phenomena. Therefore, water and impurities need to be removed.

3.3 Cutting Oil Treatment Test Procedure

Combined with the oil used in the crankshaft turning processing site, the flow path of oil for marine crankshaft in the processing process was surveyed. The cutting oil purification process flow was developed, as shown in Figure 1.

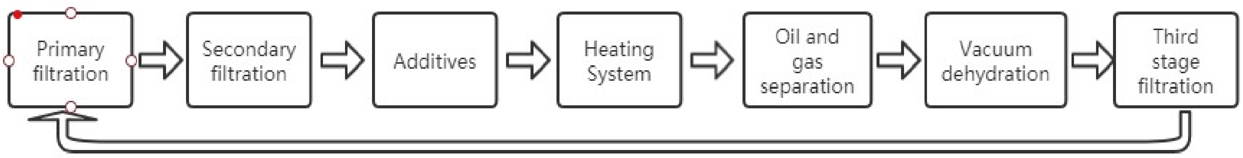

Figure 1. Cutting oil purification process

The primary filtration adopts the form of filter bag, which is low cost and convenient for the removal of larger impurities, and the filter mesh is 200 mesh. The secondary filtration adopts stainless steel filter element with a filtration precision of 50 μm, which can be used repeatedly after cleaning to save cost.

The equipment adopts automatic temperature control heating system to warm up the oil, the temperature setting range is 20 ℃ ~ 80 ℃, the cutting oil has been tested at 50, 55, 60, 65 ℃ to see

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the effect, 60 ℃ purification efficiency is higher and will not damage the oil, the reason is to prevent the oil additives due to heat decomposition, and can play a role in reducing the viscosity of the oil treatment, improve the efficiency of impurity filtration. The oil is atomized by the atomizer, which makes the oil and the moisture gas separated as much as possible, the moisture evaporates and the excess gas is extracted and enters the poly tank. The oil droplets then enter the vacuum tank for vacuum dehydration with a vacuum of -0.098 Mpa. The condenser is used to make the water gas in the vacuum separation system condense quickly and enter the water storage pipe to prevent water from entering the vacuum pump, while the oil is gathered and discharged through the oil discharge pump. The equipment is automatic start-stop type, using solenoid valve automatic control, temperature fluctuation range will not exceed 5 ℃. After treatment, the water of cutting oil is reduced to below 500 PPM, and finally the fine particulate impurities are treated by three-stage filtration. After experiments, it is concluded that the three-stage filtration adopts 5 μm filter element with the best effect and 10 μm with poor effect, and additive treatment is carried out to reduce the viscosity and improve its cooling, and the models of 5 μm and 10 μm filter elements are SN-5 and SN-10 respectively.

The heating system is interlocked with the vacuum system and oil discharge system, and the heating system can be started only after the vacuum pump and oil pump are started to avoid the high oil temperature from damaging the equipment; the equipment is equipped with an automatic alarm device, and when the pressure in the equipment is too large, the water cannot be removed better, and even the cartridge is damaged, so the filter bag needs to be replaced and the cartridge needs to be cleaned in time.

4. Results and Analysis

Table 1. Test Data Results

	Before processing	After processing	Recycling standards	Test Method
Color	Gray-black opaque	Light brown more transparent	Anomalies	Visual inspection
Kinematic Viscosity (mm2/s)	76	32	<35	GB/T 265-1998
Moisture(PPM)	6055	98	<500	GB/T 260-1977
Granularity(NAS)	12	8	/	GJB 380.8A-2004
Acid (mg KOH/g)	0.428	0.032	≤1	GB 264-1983
Mechanical impurities(%)	2.120	0.054	≤0.5	GB/T 511-2010

Using the process flow shown in Figure 1, waste cutting oil was pumped into a clean oil drum (200 L) and treated with an industrial oil purification system for 1 h after cycling, and the data changes before and after comparing crude oil and waste oil purification are shown in Table 1. The experiments show that the best treatment conditions are: the treatment time is 3 cycles, the constant temperature is adjusted to 60 ℃, the combination of filtration precision is 75μm-50μm-5μm, and the additive is D80 with 10 % volume fraction. the contaminant level of the treated cutting oil is reduced from NAS12 to NAS8, and the viscosity, moisture, mechanical impurities and other indicators reach the recycling standard.

It is proved that the cutting oil purification and regeneration process system developed in this paper provides an effective way to realize the recycling of resources, and has a certain role in promoting the green manufacturing and industrial upgrading advocated by China.

4.1 Analysis of Test Results

The moisture and kinematic viscosity, granularity, appearance and tapping torque values of cutting oil before and after treatment were analyzed, and the effect of the number of treatment cycles and treatment temperature on the dewatering rate, the effect of different combinations of filtration degrees on debris removal, and the effect of the presence or absence of additives on viscosity changes were analyzed to optimize the cutting oil purification and treatment process.

4.1.1 Moisture and Kinematic Viscosity Analysis

Moisture and viscosity tests were performed on cutting oil crude oil, lubricating oil and waste cutting oil, and the results are shown in Table 2. It can be concluded that there is a large amount of water mixed in the waste cutting oil, and the viscosity of the low-viscosity cutting oil increases due to the mixing of high-viscosity lubricating oil during the use of the two crude oils when they are used at the same time in processing.

Table 2. The properties of cutting oil crude oil, lubricating oil and used cutting oil

	Crude cutting oil	Lubricants	Waste cutting oil	New oil standards	Test Method
Moisture(PPM)	30	32	6055	<500	GB/T 260-1977
Kinematic Viscosity (mm2/s)	44	1525	76	+15 or -20	GB/T 265-1998

By adding different volume fractions of additive D80 and isomeric hexadecane hydrocarbon to the waste cutting oil, the viscosity changes were detected, and the results, as shown in Figure 2 and Figure 3.

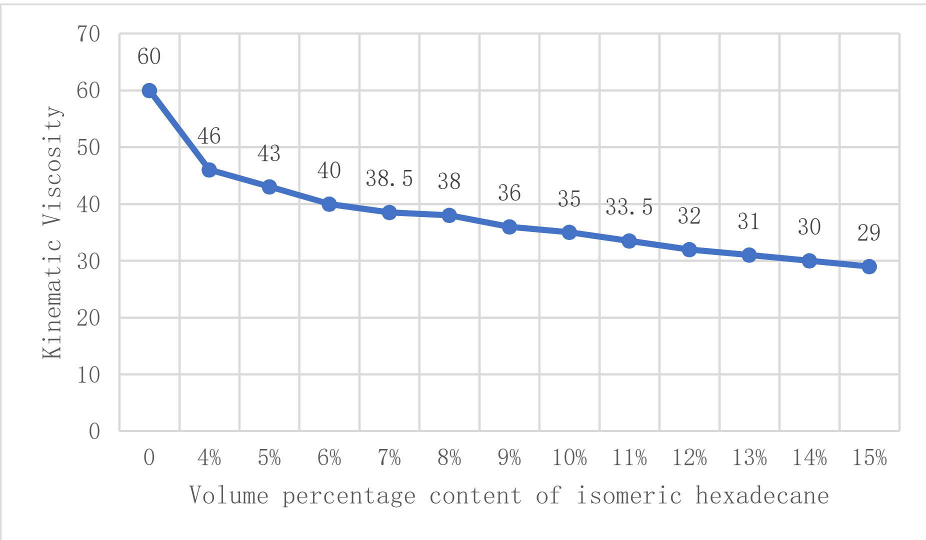

Figure 2. Isomeric hexadecane content / kinematic viscosity after treatment line graph

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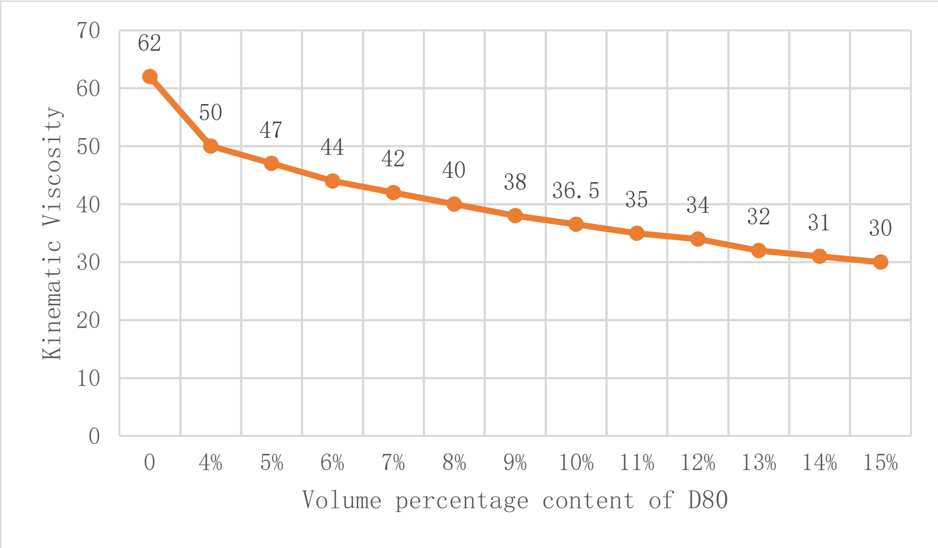

Figure 3. D80 content / kinematic viscosity after treatment line graph

The results show that the two additives have similar viscosity reduction effects, and D80 was finally chosen as the additive due to its lower cost and almost no odor. From Figure 2 and Figure 3 can be treated oil viscosity decrease slowly, and according to the kinematic viscosity of crude oil is about 32, take the percentage content 10 % cost-effective content is higher.

After purifying and regenerating the waste cutting oil, the experimental results are shown in Table 1, the kinematic viscosity of the waste cutting oil is reduced from 76 to 32, and the moisture content is reduced from 6055PPM to 98PPM, which meets the national standard. The removal of water will help the cutting oil form a good lubricating film between the tool and the workpiece. After testing, the kinematic viscosity of the lubricant mixed in the cutting oil is much larger than the cutting oil itself, while the viscosity of the treated cutting oil is close to that of crude oil, which is enough to greatly improve the cooling performance of the cutting oil.

4.1.2 Appearance Analysis

Figure 4. Cutting oil purification process

As can be seen from the cutting oil appearance diagram in Figure 4, the overall color of the cutting oil before treatment is brownish gray and opaque, but the particulate matter is still difficult to observe for the human eye. After leaving the cutting oil before treatment for a week, it was found that there were more black particulate matter sinking to the bottom, and after leaving it for a month, it was found that there were flocculent substances, which were analyzed as small particle size impurities such as micro dust in the air mixed in. The color of cutting oil after treatment 1 (using 10μm three-

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stage filtration) is much cleaner, but not bright enough, and there are less black particles sinking after a week of standing, and after treatment 2 (using 5μm three-stage filtration), the performance is further improved and can continue to use.

4.1.3 Elemental Analysis of Particulate Matter

The analysis in Table 3 shows that the cutting crude oil is mixed with a large number of particulate impurities, especially the elemental impurities containing P, Ca, Fe, Si, Sn, Zn, etc., and the lubricant carries a large number of P elements to make the main reason for the rise in viscosity of cutting oil, and the metal elemental impurities are caused by the mixing of external particulate matter, especially the rise in Fe, Sn, Zn content. (The following Q represents cutting oil crude oil, FQ represents waste cutting oil, R represents lubricating oil).

Table 3. Elemental testing of cutting oil crude, lubricating oil and cutting waste oil

No.	Content（$\mu g \cdot g^{-1}$）								
	Ag	Al	B	Cr	Cu	K	Mg	Mn	Mo
Q	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
R	< 1	< 1	< 1	< 1	< 1	1.2	< 1	< 1	< 1
FQ	< 1	< 1	< 1	< 1	1.2	< 1	< 1	< 1	< 1
No.	Content（$\mu g \cdot g^{-1}$）								
	Na	Ni	Pb	Ti	V	P	Ba	Ca	Fe
Q	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
R	< 1	< 1	< 1	< 1	< 1	748	9.48	21.8	< 1
FQ	< 1	< 1	< 1	< 1	< 1	80.3	< 1	3.17	11
No.	Content（$\mu g \cdot g^{-1}$）								
	Si	Sn	Zn						
Q	< 1	< 1	< 1						
R	12	< 1	1.2						
FQ	1.8	5.1	6.4						

The data of experimental results show that both cutting oil and crude oil before treatment contain more impurities, but the metal element content of crude oil is much lower than the waste oil content, which can be seen that the waste oil contains a large amount of Fe, Sn, Zn and other metal impurities, while the rise of P element is caused by the mixing of another lubricant, which leads to a certain improvement of cutting oil lubricity instead, but has an impact on cooling. According to Table 1, the particle size of cutting oil after purification and regeneration treatment was reduced from 12NAS to 8NAS, and the mechanical impurities were reduced from 2.12% to 0.054%, all of which met the regeneration standard.

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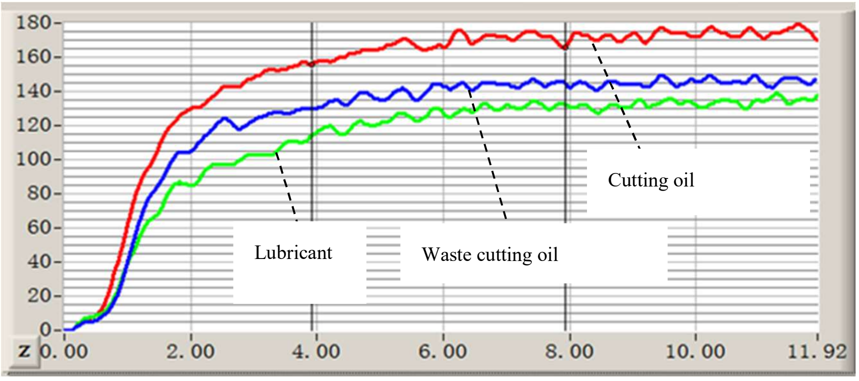
4.1.4 Tapping Torque Analysis

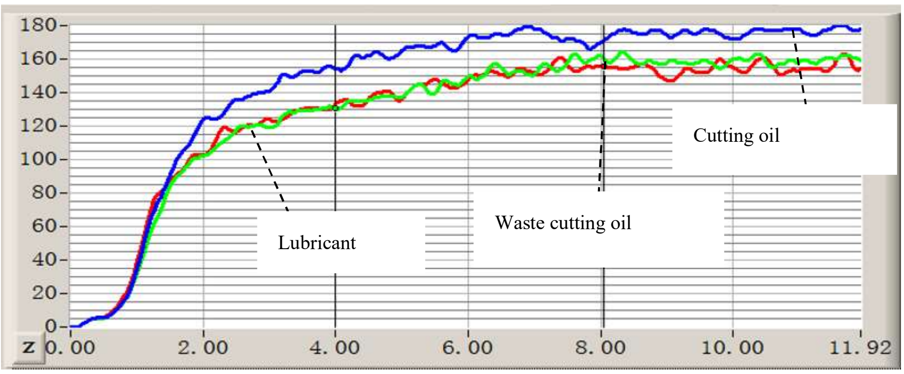
The tapping torque test was conducted on the cutting waste oil, cutting crude oil and lubricating oil before purification treatment, and the experimental results are shown in Figure 5, which shows that the torque values of FQ, Q and R are 140.2 NCM, 167.5 NCM and 125.9 NCM respectively. The reason for this is that R is a high viscosity oil and Q is a low viscosity oil. When forming the oil film, R has a thicker film and better lubricity, while FQ has a higher viscosity due to the mixing of Q with R oil, which increases the lubricity.



REF		Max	Mean	Std dev	[ntegral	dTemp %	Mean %	Std dev %
		176. 0	167. 5	5. 2	663	100. 0	100. 0	100. 0
		134. 0	125. 9	5. 5	499	0. 0	75. 2	105. 4
		147. 0	140. 2	4. 7	555	0. 0	83. 7	89. 7

Figure 5. Lubricating oil, cutting waste oil, cutting crude oil tapping torque average

By purifying and regenerating the waste cutting oil by adding 10 % D80, the tapping torque test results are shown in Figure 6, showing a torque value of 147.2 NCM, with improved lubricity compared to the pre-treatment, while the torque values measured by cutting oil crude and lubricating oil are almost the same as those measured before, avoiding the chance of the test.



REF		Max	Mean	Std dev	[ntegral	dTemp %	lean %	td dev
		161. 0	146. 7	7. 7	587	100. 0	100. 0	100. 0
		163. 0	147. 2	9. 0	589	0. 0	100. 3	116. 1
		179. 0	168. 8	6. 3	675	0. 0	115. 0	81. 2

Figure 6. Average of tapping torque after adding D80

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4.2 Analysis of the Factors Influencing Vacuum Dehydration

Vacuum dewatering is to use the principle that the boiling point of cutting oil decreases under near vacuum conditions and the boiling point difference between oil and water is large, so that the oil-water mixture enters the atomizer to atomize and then enters the reactor to make the water and gas in the oil volatilize, thus realizing the oil-water separation of cutting oil. Generally speaking the higher the vacuum degree, the higher the dewatering efficiency. For the treatment process, the temperature environment, the number of cycle work, etc. will have an impact on the vacuum dehydration efficiency, and then affect the oil purification effect.

4.2.1 Effect of Number of Cycles on Dewatering Rate

The measurement conditions: the temperature was 50 ℃, the filtration accuracy was up to 50 μm, and the number of working operation cycles was 1, 2, 3, 4, 5. The experimental results are shown in Figure 7.

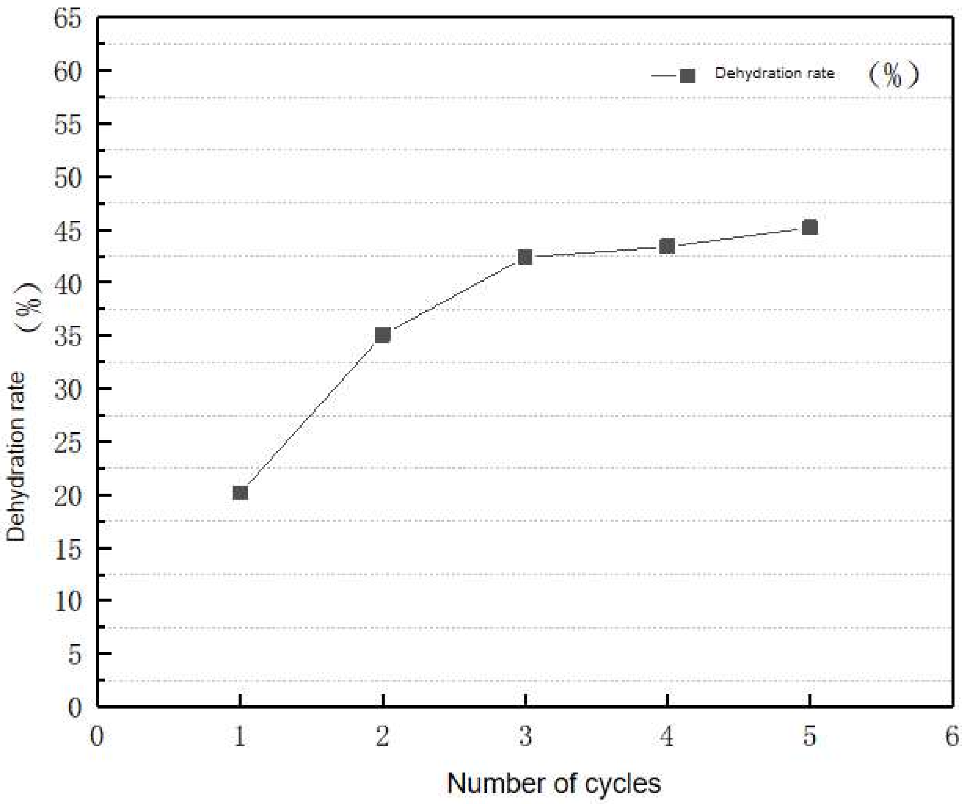

Figure 7. Influence law of the number of cycles on the dewatering rate

From Figure 7, it can be seen that the dewatering rate gradually increases with the increase of cycle times, which is because the dewatering rate is in the trend of increasing with the extension of running time when the vacuum degree and temperature remain unchanged, but when the number of cycles is greater than 3 times, the growth trend of dewatering rate is slow and almost no change, which may be due to the fact that the temperature and filtration precision may not be the best conditions, resulting in the inability of the dewatering rate to rise, while the analysis shows that the optimal number of running cycles is 3 times.

4.2.2 Effect of Temperature on Dehydration Rate

Measurement conditions: 3 cycles of working operation, filtration precision up to 50 μm, heating temperature of 50 ℃, 55 ℃, 60 ℃, 65 ℃, respectively. The experimental results are shown in Figure 8.

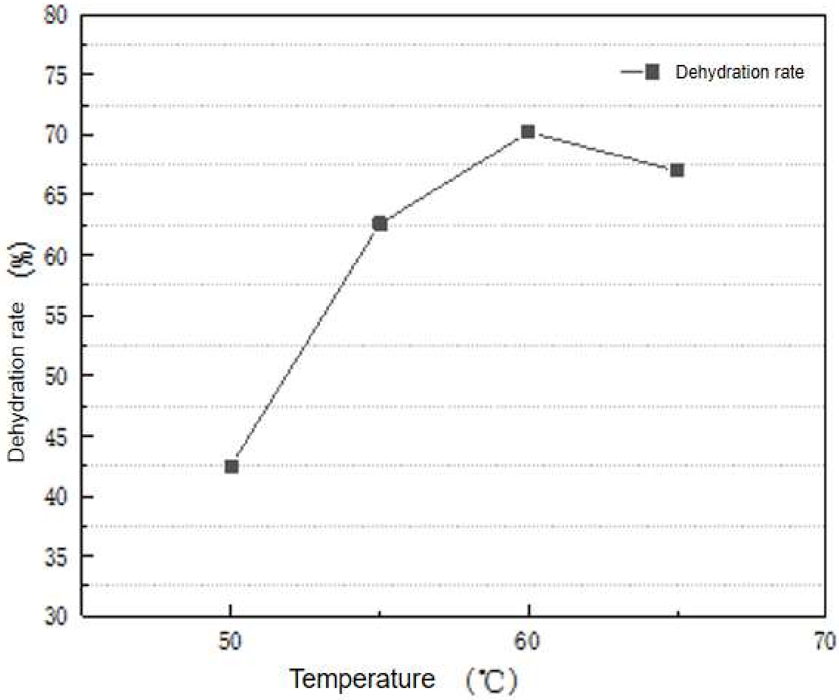

Figure 8. Influence law of temperature on dehydration rate

From Figure 8, it can be concluded that the dewatering rate increases continuously as the temperature increases, reaching a peak when the temperature rises to 60 ℃ and begins to decrease when it continues to rise to 65 ℃. This is because the high temperature may cause an increase in dissolved water in the oil, or it may be that partial oxidation or thermal cracking occurs, which leads to an increase in acid value or the generation of precipitates, and the contaminants increase the possibility of water adsorption by the contaminants at a lower filtration accuracy.

4.3 Comprehensive Analysis of Cutting Oil Degradation and Deterioration Causes

After the relevant test shows that the cutting oil used in the impurity water fraction is high, the analysis is due to the cutting oil is in the exposed air for a long time, by the temperature change especially the rain weather, and the cutting oil site in the environment of heavy moisture, a large amount of water will carry many airborne dust, immersed in the oil, resulting in the accumulation of flocculants increased, the appearance of the oil obviously changed; a large amount of water dissolved in the A large amount of water dissolved in the cutting oil, will form very small particles of water in oil, these water in oil particles mixed in the cutting oil, will reduce the cutting oil permeability and wettability, resulting in cutting oil in the work can not be timely in the workpiece and tool surface between the formation of a good lubricating film, so that the cutting oil lubrication performance is greatly reduced. The presence of too much moisture will also lead to the growth of bacteria, which will lead to the production of some carcinogenic oil mist in such an environment, affecting the workshop environment and seriously threatening the health of employees.

Cutting oil in the process of use inevitably exist some cutting metal debris flow into the oil circulation channel, will be large particles of chips through the chain belt transfer to the waste box, seemingly no impact on the circulation process of cutting oil, but more chips are not observable to the human eye, the smaller the number of micron chips in the cutting oil, is a stepped order of magnitude distribution. Due to the presence of chips, especially the presence of iron elements as a catalyst in the oil, the cutting oil has a catalytic oxidation, resulting in the darkening of the oil sink, producing a lot of flocculent, the oil degradation occurs significantly. The excessive presence of metal impurities also makes the heat dissipation of cutting oil poor, so that its cooling and lubricating properties and antioxidant performance is greatly reduced.

As mixed with higher viscosity lubricants, cutting oil in the work of insufficient heat dissipation, the temperature of localized increases lead to oil deterioration and degradation, coupled with the continuous consumption of the original additives in the oil, the oil flash point gradually reduced, easy to start a fire. Day after day will not only cause impact on the oil itself, but also cause greater impact on the workpiece tool, and even cause certain hidden danger to the machine tool and other external equipment, bringing huge risk of economic loss to the enterprise.

5. Conclusion

moisture in the air and environmental factors lead to excessive moisture in cutting oil, affecting the workpiece surface processing accuracy, after the industrial oil purification system treatment of cutting oil moisture index is restored, lubricity is improved, greatly reducing the breeding of bacteria and oil mist generation.

The mixing of metal chips and external impurities in cutting oil causes its heat dissipation to be greatly reduced, and the oil will be catalytically oxidized and degraded after deposited for a long time, while the cutting oil is clean and transparent after treatment, and the indexes of particle elements are restored, which reduces the influence and hidden risks to tools and machine tools, and improves the cooling and lubricating properties of cutting oil.

Because the cutting oil is mixed with relatively high viscosity lubricating oil, resulting in its viscosity greatly from the standard of crude oil, making the cutting oil heat transfer coefficient rise, after the additive treatment has been restored, the cutting cooling effect after treatment greatly improved, to avoid the occurrence of tool bonding phenomenon.

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